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(54) EVALUATION METHOD FOR LUSTER OF SKIN

(57)Abstract:
PROBLEM TO BE SOLVED: To provide an evaluation method capable of objectively measuring the luster of the skin and giving an evaluation similar to the one by an observation with naked eyes.
SOLUTION: This evaluation method for the luster of the skin comprises: (1) a process of picking up the image of the skin of a testee and obtaining digital image data; (2) a process of taking out the data of mirror reflected light components of respective pixels from the digital image data; (3) a process of obtaining the average value of the brightness of the respective pixels from the data of the mirror reflected light components and defining it as physical glossiness; (4) a process of squaring the data of the respective pixel components of reconstituted image data, obtaining the average value and defining it as an apparent roughness; and (5) a process of expressing the luster state of the skin by the physical glossiness and the apparent roughness of a skin surface. Then, in the process (5), the data of the mirror reflected light components are separated into the data of a plurality of different frequency components by multiple resolution analysis, and two or more pieces of the data of middle frequency components expressing the texture of the skin are selected from the data, and the selected data are composited and turned to the reconstituted image data.

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CLAIMS

[Claim(s)]
[Claim 1]
The following process (1) thru/or (5),
(1) The process which picturizes a test subject's skin and obtains digital image data,
(2) Take the data of the specular light component of each pixel from digital image data, and it is appearance.
******,
(3) Calculate the average of the brightness of each pixel from the data of a specular light component, and it is physics.
The process made into **** glossiness,
(4) While give the data of a specular light component to multiplex resolution analysis, separating into the data for every frequency component with which plurality differs and expressing the texture of the skin out of this data, choose two or more data of a frequency component, compound selected data, consider as reconstruction image data, and carry out the square of the data of each pixel component of this reconstruction image data,
The process which calculates the average and is made into the granularity of the appearance on the front face of the skin,
(5) By the granularity of the appearance of the aforementioned physical glossiness and an aforementioned skin front face, it is the luster condition of the skin.
The process to express
The evaluation approach of the luster of ********.
[Claim 2]
The evaluation approach of the luster of the skin given in the 1st term of a claim which takes out the data of a specular light component from digital image data using 2 color reflection model.
[Claim 3]
The 1st term of a claim which divides a specular light component into the data for every frequency component with which plurality differs by repeating wavelet transform and wavelet inverse transformation, or the evaluation approach of the luster of the skin given in the 2nd term.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention]
This invention relates to the evaluation approach that the luster of the skin can be evaluated objective in a detail, further about the evaluation approach of the luster of the skin.
[0002]
[Description of the Prior Art]
The luster on the front face of the skin is an element very important when expressing the result after the health condition of the skin, beauty, or makeup. Therefore, it is one of the important purposes of basic cosmetics or makeup cosmetics to give the suitable luster for the skin.
[0003]
In order to develop cosmetics with such effectiveness, "luster of the skin" needs to measure objective whether the condition of the gloss of what kind of the skin is pointed out.
[0004]
However, as for in addition to the property of the skin as matter, receiving the effect of the configuration on sebum, the makeup film, and the front face of the skin etc., and it being judged as "******", giving a bad impression, and evaluating the luster of the skin only by value of 1-dimensional one like glossiness, a problem has the luster of the skin.
[0005]
It picturizes, where the light and darkness on the front face of the skin are conventionally emphasized as an approach of judging "******" and a "fat float" of the skin and evaluating, and image data is obtained, the pixel of ** beyond a fixed threshold and the pixel of the other dark are classified after this, and the number of the pixels of ** and the method of asking for the area rate that this occupies are learned (patent reference 1 reference).
[0006]
However, this approach was what has [whether after all a result may change and how to decide a threshold moreover by measuring gloss can estimate the luster of the skin objective, and] a question.
[0007]
[Patent reference 1]
Patent No. 3236731
[0008]
[Problem(s) to be Solved by the Invention]
Therefore, the luster of the skin could be measured objective and offer of the evaluation approach that the same evaluation as macroscopic observation can be given was called for.
[0009]
[Means for Solving the Problem]
When this invention persons were inquiring wholeheartedly so that they may solve the above-mentioned problem, they have noticed it decided by the texture of the skin that the gloss of the desirable skin will be physical glossiness. And a header and this invention were completed for the approach of asking for "the apparent granularity" showing glossiness and texture by image analysis from one digital color picture.
[0010]
That is, this invention is the following process (1) thru/or (5),
(1) The process which picturizes a test subject's skin and obtains digital image data,
(2) The process which takes out the data of the specular light component of each pixel from digital image data,
(3) The process which calculates the average of the brightness of each pixel from the data of a specular light component, and is made into physical glossiness,
(4) The process which chooses two or more data of a frequency component while give the data of a specular-light component to multiplex resolution analysis, separate into the data for every frequency component with which plurality differs and expressing the texture of the skin out of this data, compounds selected data, considers as reconstruction image data, carries out the square of the data of each pixel component of this reconstruction image data, calculates the average, and makes into the granularity of the appearance on the front face of the skin,
(5) The process which expresses the luster condition of the skin by the granularity of the appearance of the aforementioned physical glossiness and an aforementioned skin front face
The evaluation approach of the luster of ******** is offered.

[0011]
[Embodiment of the Invention]
In order to enforce this invention approach, it is required to picturize the skin image of a specimen and to obtain digital image data first.

[0012]
This image pick-up can be performed using a common digital camera, and if digital image data is obtained in forms, such as a RGB value, there will be especially no constraint about that number of pixels.
[0013]
Although a specular light component and an internal reflection component exist in the obtained digital image data, generally the color of specular light is the same color as the self-luminous color, and it is supposed that the color of internal reflection is become the color of a proper at a body. Although this phenomenon is called 2 color reflection model, in this invention, the data of the specular light component of each pixel are taken out out of digital image data using this model.
[0014]
That is, according to the 2 color reflection model, the measured value i of each pixel which is the pixel data of a digital image (R, G, B) can be expressed like the following formula (1) using the beige unit vector kB (Br, Bg, Bb) and the self-luminous color unit vector kS (Sr, Sg, Sb). The inside of a formula, iS Specular light reinforcement, iB It is internal reflection reinforcement.
[0015]
[Formula 1]

$$i = \mathrm{i}_S k_S + \mathrm{i}_B k_B = \begin{pmatrix} \mathrm{i}_s & \mathrm{i}_B \end{pmatrix} \begin{pmatrix} k_S \\ k_B \end{pmatrix} \qquad (1)$$

[0016]
If it is with a matrix and expresses about the measured value of all image data, it can express like a formula (2).
[Formula 2]

$$I = I_{SB} K_{SB} \qquad (2)$$

[0017]
However, since the matrix of nx2 and KSB of the matrix of nx3 and ISB are the matrices of 2x3 and KSB of I is not a square matrix, ISB does not become settled uniquely. Then, it is with general Moore-Penrose (Moor-Penrose) mold inverse-matrix KSB+, and the reflected light matrix ISB on the strength is presumed by the formula (3).
[Formula 3]

$$I_{SB} = IK_{SB}^{+} \qquad (3)$$

[0018]
It can ask for the data of the specular light component for every pixel by doing in this way. And the average of the brightness of each pixel of the data of this specular light component is calculated, this is made into physical glossiness, and it considers as the 1st element of luster evaluation of the skin.
[0019]
Next, the data of the specular light component obtained as mentioned above are divided into the frequency component from which plurality differs in multiplex resolution analysis, and each data is obtained.
[0020]
That is, the frame of a face, flesh and pore, the shape of surface type of a ripple, and the effect of sebum distributed over a front face are included in the data of the separated specular light component. That is, the data of a specular light component are considered to be composition of the fluctuation component of various scales. The component originating in a configuration with detailed skin front faces, such as pore, a ripple, etc. which are considered to have various effects on texture, is separated out of this fluctuation component.
[0021]
Separation of this fluctuation component decomposes image data into the linear combination of other images, and is performed by the multiplex resolution analysis which examines the description of the original image data. More specifically, two-dimensional high-speed wavelet transform decomposes the data of the specular light component which is image data into the error image of the high frequency component which is the error of the approximation image approximated more with the function of low frequency, and the original image. And the image in which a high frequency component is shown can be obtained from the low-frequency component of a former image by an approximation image being with wavelet transform further, and decomposing. And it is possible to reconfigurate a former image by compounding suitably the image disassembled into the high frequency component from the low-frequency component. Disassembly of

this image and reconstruction can be performed using 2 thru/or the 10th DOBISSHI (Daubechies) wavelet (N=2-10).
[0022]
It is as being shown in drawing 1 for explanation, if little level indicates the procedure of this wavelet transform and wavelet inverse transformation. That is, from the original image data, by wavelet transform, three high frequency image data and one low frequency image data are obtained, wavelet inverse transformation of three of the high frequency image data of this is carried out, and it considers as the image data (data of the highest frequency) of level 1. Subsequently, wavelet transform of the low frequency image obtained in the top is carried out again, and three new RF images and one low frequency image are obtained. Wavelet inverse transformation of three of the high frequency images of this is carried out twice, and it considers as the image data (data of a frequency high to the 2nd) of level 2. Furthermore, wavelet transform is performed about the above-mentioned low frequency image, wavelet inverse transformation of the three obtained high frequency images is carried out 3 times, and it considers as the image data (data of a frequency high to the 3rd) of level 3. Although drawing 1 R> 1 has not indicated any more, two or more image data to low frequency from high frequency can be obtained by repeating the above-mentioned procedure successively. On the other hand, wavelet inverse transformation of the low frequency image data obtained as a result of the 3rd wavelet transformation is carried out 3 times, and it is taken as the image data of level 3F.
[0023]
Among these image data, from from, while it is thought that pore, a ripple, etc. are reflected, two or more image data of a frequency component is taken out, these data are compounded, and it considers as reconstruction image data. And the square of the data of each pixel component of this reconstruction image data is carried out, the average is calculated, this is made into the granularity of the appearance on the front face of the skin, and it considers as the 2nd element of luster evaluation of the skin.
[0024]
Thus, the luster condition of the skin is expressed as the obtained physical glossiness based on the granularity of the appearance on the front face of the skin. Although various approaches can be considered, it may be plotted and shown on XY flat surface, and this numeric value is substituted for a certain equation, for example, you may make it computed as a glossiness characteristic of the skin etc. as the expression approach, for example.
[0025]
[Function]
This invention has the description as a value which shows the texture other than gloss to evaluation of the luster of the skin at the point of having carried in the concept of "granularity of the appearance on the front face of the skin."
[0026]
Even if it is the skin made the same according to this invention approach when gloss is measured since such a concept was carried in, it becomes possible to distinguish the condition that there is luster of the original desirable skin from the case where there are "******", a "fat float", etc.
[0027]
[Example]
Although an example is given and this invention is explained in more detail hereafter, this invention is not restrained at all by these examples.
[0028]
Fruit ** Example 1
Calculation of the granularity of the appearance on the physical glossiness of the skin, and the front face of the skin :
About the same person, six kinds of samples from which a feeling of gloss differs were created by changing the spreading condition of the foundation for a frame. Under artificial sunlight lighting, the sample was photoed with the digital camera and made into the sample image data (full color 512x512 pixels 24 bits) used for analysis. One of the sample images used for analysis is shown in drawing 2 .
[0029]
About these images, the reflected light matrix ISB on the strength was searched for using general Moore-Penrose (Moor-Penrose) mold inverse-matrix KSB+ using the measured value i (R, G, B) and the measured self-luminous color unit vector kS (Sr, Sg, Sb) of each pixel based on 2 color reflection model. It asked for specular light reinforcement one by one about each pixel, and the average of this brightness was made into physical glossiness. In addition, that which imaged the data of specular light reinforcement for which it asked from drawing 2 is drawing 3 R> 3. Shading which reflected the configuration on the front face of the skin in the image of drawing 3 is emphasized, and it turns out after this analysis that the information on texture is not spoiled.
[0030]
On the other hand, in order to separate the component showing texture from the data of the above-mentioned specular light reinforcement, wavelet transform and wavelet inverse transformation were used, and multiplex resolution analysis was performed. In the above-mentioned conversion and inverse transformation, image size was made into 256 pixel x256 pixel, and used the DOBISSHI wavelet of N= 4. That which imaged the data which carried out multiplex resolution analysis of the specular light data on the strength for the situation which carried out multiplex resolution analysis of the change of the brightness on the straight line on an image to level 8 at drawing 4 is shown in drawing 5 . Level 8F are the approximation image which approximated drawing 3 with the function of low frequency. The image of 8 is an error image showing the error component of an approximation image and the specular light image of drawing 2 from level 1. The error image of a low-frequency component is shown as level 1 shows the error image of a high frequency component most and level becomes large. The specular light image of drawing 3 can be reconfigurated in totaling the image of all level.
[0031]
From drawing 5 , more, the description of shading on the front face of the skin compounded only the inside frequency component of the level 3-6 which has appeared well, and considered as reconstruction data. What carried out the image of this reconstruction data is shown in drawing 6 . This image has the property in which shading of the component of this image is emphasized, when shading with a detailed skin front face is separated from the specular light image shown in drawing 3 characteristic and appearance looks coarsely

under the effect of the case where a skin front face is coarse, the makeup film, sebum, etc. Then, the square of the data of each pixel component of this reconstruction data was carried out, the average was calculated, this was made into "apparent granularity", and it considered as the index showing texture.

[0032]

Fruit ** Example 2

Correlation with the granularity of the appearance on the front face of the skin, and the mental glossiness by organic-functions evaluation :

I had six persons' panel look at six sample images used in the example 1, and mental glossiness was evaluated by the strange method of Nakaya of a paired comparison. It was referred to as A, B, C, D, E, and F from the thing with the high mental glossiness at order.

[0033]

When this figure and the value of "the apparent granularity" stopped also in the above-mentioned example 1 were plotted, drawing 7 was obtained and it was shown that these figures have very high correlation.

[0034]

This showed that the value of "the apparent granularity" stopped also in the example 1 could be used as a thing reflecting mental glossiness.

[0035]

Fruit ** Example 3

Evaluation of the luster of the skin :

"Physical glossiness" and "apparent granularity" were plotted for six sample images used in the example 1 on the basis of the sample image F whose mental glossiness was the lowest, and drawing 8 was obtained.

[0036]

In this drawing, "physical glossiness" shows the amount of gloss, can be understood that "apparent granularity" is what shows the quality of gloss, and can grasp the relative physical relationship of the gloss between images. And since the direction of an axis of abscissa means the quality of gloss and the direction of an axis of ordinate means the amount of gloss in drawing 8 for example, after grasping the luster condition of the skin present in the inside of this drawing, it becomes possible to raise the makeup effectiveness by choosing the foundation which gives the direction of a desirable luster condition more.

[0037]

[Effect of the Invention]

this invention approach is useful when evaluating the efficacy of being able to express clearly the luster of the skin which was ambiguous until now qualitatively [of gloss / the amount and qualitatively], and giving luster to the skin. Therefore, in development of the new charge of skin makeup etc., it can use advantageously.

[0038]

Moreover, since this invention approach can use and carry out the computer incorporating a digital camera, etc. predetermined count, or an analysis type, it can evaluate the luster of a customer's skin easily at cosmetics counters, such as a chemist's shop and a department store, and can use it for the sales promotion of cosmetics etc.

[Brief Description of the Drawings]

[Drawing 1] The drawing in which the procedure of wavelet transform and wavelet inverse transformation is shown

[Drawing 2] The photograph in which the example of the sample image used for analysis is shown

[Drawing 3] The photograph which imaged the data of specular light reinforcement for which it asked from the sample image

[Drawing 4] The drawing in which the situation which carried out multiplex resolution analysis of the change of the brightness on the straight line on an image is shown

[Drawing 5] The photograph which imaged the data which carried out multiplex resolution analysis of the specular light data on the strength

[Drawing 6] The photograph which imaged reconstruction data

[Drawing 7] The drawing in which correlation with the granularity of the appearance on the front face of the skin and the mental glossiness by organic-functions evaluation is shown

[Drawing 8] The drawing which expressed the luster of the skin by the granularity of physical glossiness and appearance

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DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] The drawing in which the procedure of wavelet transform and wavelet inverse transformation is shown
[Drawing 2] The photograph in which the example of the sample image used for analysis is shown
[Drawing 3] The photograph which imaged the data of specular light reinforcement for which it asked from the sample image
[Drawing 4] The drawing in which the situation which carried out multiplex resolution analysis of the change of the brightness on the straight line on an image is shown
[Drawing 5] The photograph which imaged the data which carried out multiplex resolution analysis of the specular light data on the strength
[Drawing 6] The photograph which imaged reconstruction data
[Drawing 7] The drawing in which correlation with the granularity of the appearance on the front face of the skin and the mental glossiness by organic-functions evaluation is shown
[Drawing 8] The drawing which expressed the luster of the skin by the granularity of physical glossiness and appearance
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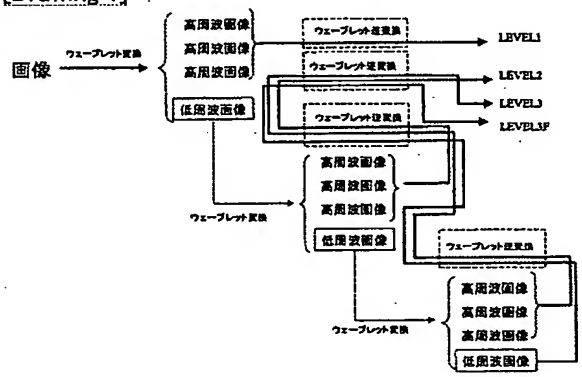
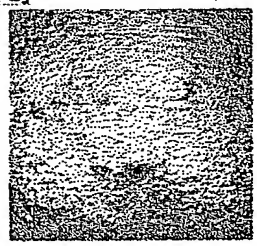
DRAWINGS

[Drawing 1]

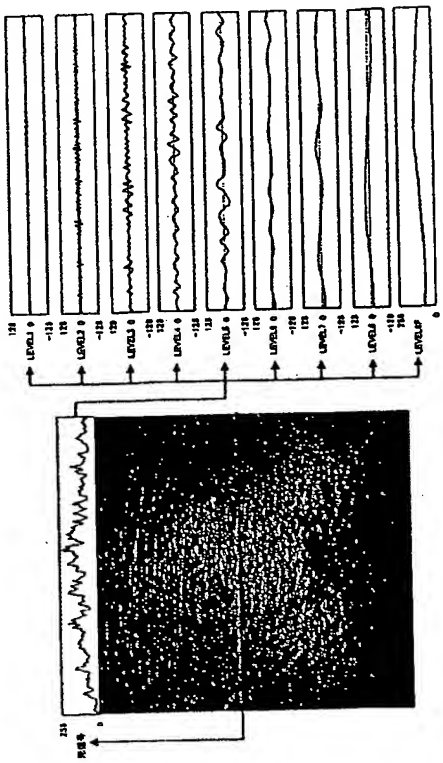


[Drawing 2]

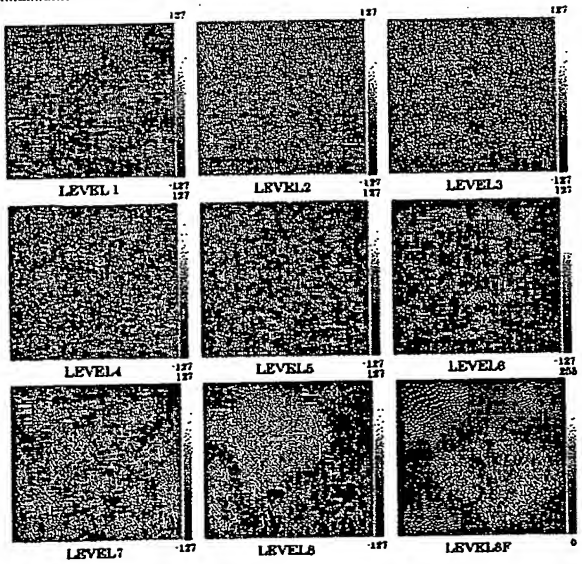


[Drawing 3]

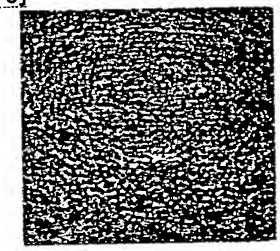
[Drawing 4]



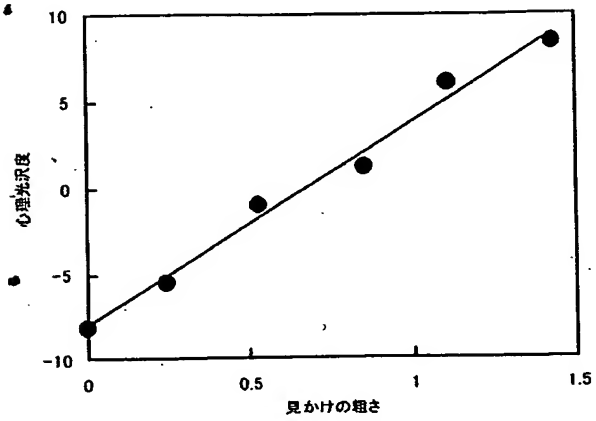
[Drawing 5]



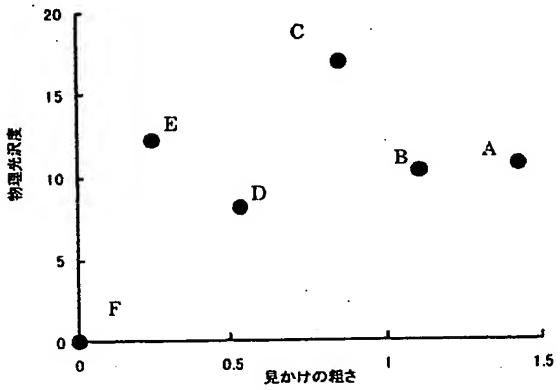
[Drawing 6]



[Drawing 7]



[Drawing 8]



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